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Attachment 1


TENTATIVE AGENDA

NPIC Technical Development Symposium

15 November 1966

| | | | |
|-----------|---|---|-------|
| 0800-0830 | Check-in/Registration | | |
| 0830-0900 | Introductions and Program Objectives | | |
| 0900-1000 | Information Handling, Phase I Report |  | 25X1A |
| 1000-1015 | Coffee Break | | 25X1A |
| 1015-1045 | Information Handling, Phase II Objectives |  | |
| 1045-1100 | Discussion period | | |
| 1130-1230 | Lunch | | |
| 1230-1400 | Unconventional Imagery |  | 25X1A |
| 1400-1415 | Discussion Period | | |
| 1415-1430 | Coffee Break | | |
| 1430-1600 | Image Analysis | | |
| 1600-1630 | Questions and Answers Period | | |

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| 0800-0900 | Automatic Stereo Scanning |  | 25X1A |
| 0900-0915 | Discussion Period | | |
| 0915-0930 | Coffee Break | | |
| 0930-1030 | Automatic Target Recognition | | |
| 1030-1045 | Discussion Period | | |
| 1045-1200 | Human Factors | | |
| 1200-1300 | Lunch | | |
| 1300-1400 | Discussion Period | | |
| 1400-1630 | Individual Discussions | | |

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Attachment # 2

HUMAN FACTORS PROGRAM

The Human Factors Program is a long-range effort designed to increase human productivity in the exploitation process at NPIC. The program will attempt to alleviate any known psychophysical deficiencies and, through human factors research, to make the exploitation process more efficient from the interpreters' standpoint. This long-range program will probably include research in a number of broad categories. These include: (1) development of objective measures of P.I. performance; (2) measurement of the influence of image variables as they affect P.I. performance; (3) development of ambient and display lighting criteria; (4) establishment of criteria for the selection and training of interpreters; (5) research in vision and perception; (6) research in P.I. equipment design; (7) research in the human interface with automated P.I. systems; (8) motivational research; (9) a study of P.I. performance as a function of his physiological condition.

An initial contract has been issued to the [REDACTED] for a nine-month effort. This project includes the following 12 tasks:

TASK # 1 - Detailed Design Definition Phase. The contractor, working closely with NPIC's technical monitors, shall further define and refine the Human Factors Program objectives as stated herein and in the composite [REDACTED] proposal to assure that the resultant study will best meet NPIC's present and anticipated requirements.

TASK # 2 - State-of-the-art Review. This task will include a literature search and an analysis of relevant research.

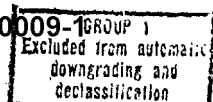
TASK # 3 - Lighting Characteristics Investigation. This task will include an examination of image interpreter performance in detection, identification, and mensuration assignments as a function of color and intensity variables in ambient luminance and display illuminance.

TASK # 4 - Visual Accommodation. This task will consist of an investigation into the feasibility of a continuous reading instrument for measuring visual accommodation without interfering with the interpreter's function.

TASK # 5 - Quantitative Determination of Image Quality. This task shall consist of manipulating the image variables of MTF, grain noise, contrast, and resolution to derive a summary measure of image quality for interpretability.

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TASK # 6 - Teaming and Scheduling. This task will involve the evaluation of image interpreter performance as a function of:

- a. individual work pacing
- b. teaming
- c. team composition

In addition to performing the above six initial tasks, the contractor will perform the following tasks (These tasks require a more intimate knowledge of NPIC operations and can only be initiated after the appropriate clearances and briefings have been administered.):

TASK # 7 - Review of NPIC Operations. The contractor is to review in depth and submit documentation of understanding of NPIC's operational imagery exploitation procedures, objectives, materials, and requirements. A limited number of key contractor personnel assigned to this program will be granted appropriate security clearances which will permit them to acquire this knowledge.

Tasks 8 through 12 will not be authorized by the contracting officer until Task 7 has been satisfactorily completed and approved.

TASK # 8 - Assessment of Value of Past and Current Research. The contractor will assess the value to NPIC of appropriate past and current human factors research. These assessments and evaluations will be directly related to NPIC's exploitation procedures, materials, objectives, and requirements.

TASK # 9 - Interpreter Performance Project Definition. The contractor shall: (a) review the factors and variables demonstrated or expected to be prime determinates of NPIC image interpreter performance and establish a priority listing of the critical experimental variables, (b) delineate and recommend a research program designed to provide the quantitative performance data which will define and describe the relationship between these variables and NPIC interpreter performance.

TASK 10 - Stereoscopic Viewing Project Definition. The contractor shall: (a) examine the factors and variables which might affect NPIC interpreter performance as a function of stereoscopic vs monoscopic viewing; and (b) define a systematic program designed to qualify the comparative performance of NPIC interpreters utilizing stereoscopic and monoscopic viewing as a function of these major factors.

TASK # 11 - Associated Contracts Review. The contractor shall serve as associate contractor and human factors consultant on other major R&D programs of the NPIC as required by the technical representative of the contracting officer. This task shall consist of: (a) examination

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of each of NPIC's other major R&D programs to determine physiological and psychophysical problems which may accrue as a result of those various programs; (b) making recommendations on, and definitions of, human factors research projects aimed at alleviating the potential problems of each of these programs.

TASK # 12 - The Preparation of an Initial Recommendation Report and Briefing. Seven months from start of contract, [REDACTED] shall make specific written recommendations in draft form and provide oral briefings regarding a five-year program. The recommendations for subsequent work shall include individual project justification, description, schedules, major milestones, expected results, estimated costs, and possible alternatives. These recommendations in no way obligate the Government to contract for these efforts. A contract review will be made by the Government upon the completion of this task.

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Attachment # 3

AUTOMATIC STEREO SCANNING PROGRAM

The Automatic Stereo Scanning Program is a long-range effort initiated to provide the image interpreter with the advantages of stereoscopic viewing during first phase photo exploitation, in which all the film from a reconnaissance mission is rapidly scanned to detect new high priority intelligence. Because the technique of stereoscopic viewing now requires exact, tedious manual alignment of two images, it is necessarily reserved for detailed analysis of selected targets, while first phase exploitation is based on monoscopic viewing.

The principal problem underlying the stereo scanning dilemma can be found in the designs of the acquisition systems which seek to optimize both resolution and area coverage. Such designs are panoramic, strip, and multi-station photographic systems which produce conjugate stereo imagery which assumes odd angular positions and widely varying stereoscopic intervals. To achieve comfortable and continuous stereoscopic fusing of such photography necessitates: (1) automatic correlation of conjugate images, (2) automatic removal of inherent image distortions, (3) presentation of a stereo model -- in stationary and slowly traveling (scanning) mode -- to the operator, (4) achieving the stereo presentation without significant degradation of image content and without significant increase in total processing time, and (5) handling the diverse outputs of existing and future acquisition systems in a manner compatible with the requirements of the operational imagery analysis components of NPIC.

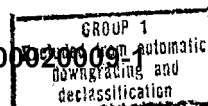
An initial contract has been issued to the [REDACTED] for a twenty-two-month effort, divided, essentially, into two phases:

PHASE I. At six months after initiation of the contract, [REDACTED] shall submit for evaluation and approval a detailed design plan and functional mock-up of an operational prototype Automated Stereo Scanner, including a revised cost proposal for the fabrication phase and containing a detailed written technical status report.

PHASE II. Upon approval of Phase I, the [REDACTED] will undertake a sixteen-month equipment development program for the fabrication of the prototype instrument. In addition to fabrication, installation, and checkout of the operational prototype Automated Stereo Scanner, [REDACTED] shall compile an approved final performance test plan, an operation and maintenance manual, recommended spare parts list, reproducible engineering drawings, monthly progress reports, a six-month (of Phase II) interim report with cost breakdown and planned course of action, and a final report after final acceptance of the prototype.

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Consideration will be given during the initial development for follow-on contracts for [REDACTED] (especially in the area of stereo projection viewing), detailed operational test of the prototype scanner, and fabrication of subsequent production-model Automated Stereo Scanners.

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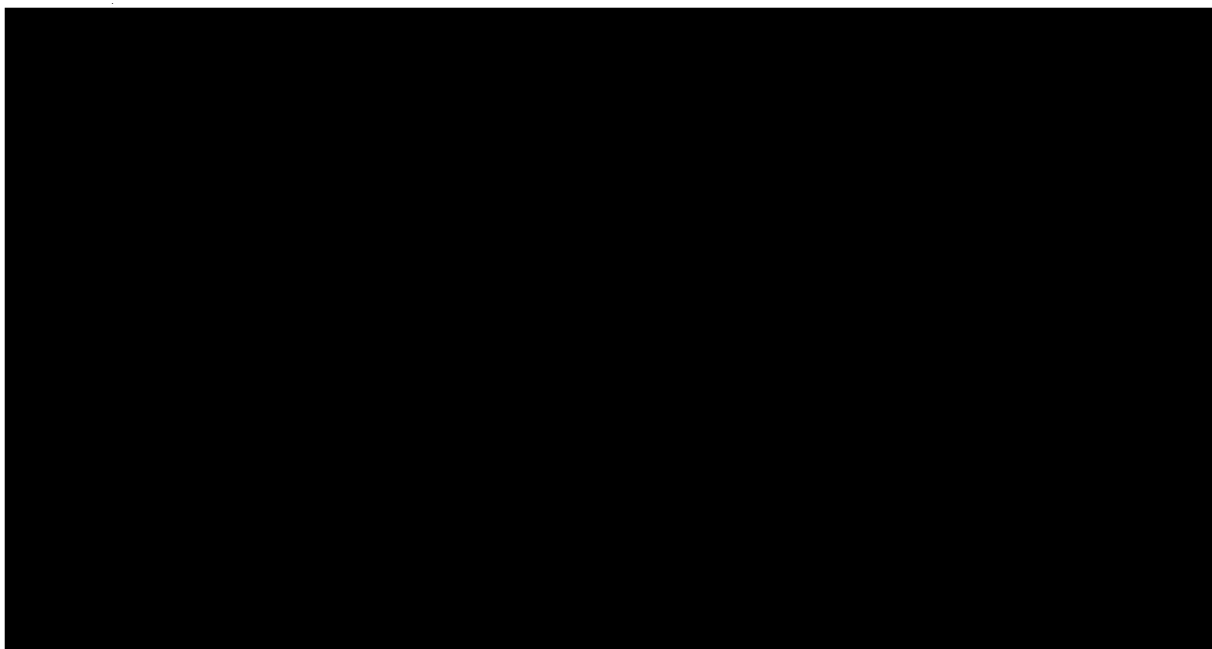
Attachment # 4

UNCONVENTIONAL IMAGERY EXPLOITATION PROGRAM

The Unconventional Imagery Exploitation Program is a long-range effort designed to provide NPIC with a capability to regularly exploit increasing volumes of imagery from unconventional collection systems. The overall objective of this program is to develop the base and technology necessary in order to provide the interpreters at NPIC with the operational equipment, techniques, and training program for exploitation of unconventional imagery for intelligence purposes.

First-year work efforts toward this objective include surveys and determination of unconventional sensor technology status; surveys and determination of associated exploitation equipment and techniques; definition of mensuration problems related to [REDACTED] [REDACTED] determination of information content and intelligence value of unconventional imagery; electromagnetic properties studies; raw signal analysis; effects of data links; exploitation equipment design concepts and specifications; and interpreter training requirements.

An initial 12-month contract has been let to [REDACTED] Under the terms of this contract, [REDACTED] is serving as consultant and contractor on unconventional imagery exploitation and is supplying the personnel, facilities, and other resources (including the services of sub-contractors and consultants) required for accomplishing the 10 tasks specified below. The sub-contractors and consultants associated with [REDACTED] and their specific investigation, are: 0



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The 10 work tasks to be accomplished during the first year's effort are as follows:

(A) A Study of Sensor Characteristics and Current Exploitation Equipment

A study of current unconventional imagery exploitation equipment and techniques; along with a concurrent study of sensor characteristics. The contractors are investigating unconventional imagery exploitation equipment, such as multiple-sensor viewers, image rectifying viewers, image manipulation equipment, etc., and will make recommendations to the Government as to the relative usefulness of existing exploitation equipment to the sponsor. Included in this task are the tabulation and evaluation of existing equipment in the Intelligence Community. Full use will be made of information contained in available equipment surveys.

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[REDACTED] will be prepared which will include descriptions of the characteristics of existing and planned collection systems and exploitation systems.

(B) Mensuration Study

A study to define mensuration problems related to current and forthcoming high-resolution [REDACTED]. The contractors are investigating the mensuration tasks performed and then analyzing the mensuration problems on the imagery created by current and future [REDACTED]. A report will be prepared summarizing the mensuration potential of each of these unconventional image-forming equipments.

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(c) Information Content of Imagery

A study of the information content, i.e., the intelligence value, of various types of imagery, based upon National Essential Elements of Information (EEI). Emphasis is being placed on radar, [REDACTED] and full color photography. The contractors are carrying out a study program designed to determine the information content of the imagery produced by the various types of unconventional imaging sensors. This study program will also determine the image quality level necessary to provide the various types of required information to answer the EEI for various intelligence purposes and will develop techniques for scientifically evaluating the information quality of the various types of imagery for specific intelligence tasks.

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(D) Interpreter's Training Requirements

A study of imagery interpreter training requirements. The contractors will recommend a program for training unconventional imagery interpreters in order that they may most effectively utilize the various types of imagery. This training program will encompass basic theory and interpretation, equipment, procedures, mensuration techniques, image enhancement and manipulation techniques, use of collateral data, and reproduction. Included in this program will be a study to determine the desired characteristics of equipment to aid the interpreters. An Unconventional Imagery Interpreter's Training Requirements Report summarizing the conclusions reached during this study, including the syllabus, will be delivered to the Government.

(E) Electromagnetic Properties Studies

A study of electromagnetic properties. The contractors are planning a long-range project of collecting data about the reflection, absorption, transmission, and emission of electromagnetic energy from various types of material. The investigation will involve the collecting of data about the electromagnetic properties of various types of materials. While this is envisioned as a continuing, long-term task, the contractor will make interim semi-annual reports to the Government summarizing the findings of this study which will be incorporated into the semi-annual report.

(F) Data Link Transmission of Imagery

A study will be made of the implications to NPIC of imagery received via electronic data link. This study will predict equipment requirements, handling procedures, etc., related to transmitted imagery. The study will estimate, as closely as possible, the time frames and costs of exploiting transmitted material. The study will include a description of existing systems.

(G) Raw Signal Analysis

An investigation of raw signal manipulation and analysis. This will include image data received in some storage form other than interpretable imagery, e.g., magnetic tape or digital data, which are convertible to interpretable imagery. The investigation will determine the optimum and alternate methods of utilizing the raw signals for specific exploitation purposes. The contractor will submit a report summarizing his findings and recommendations for follow-on work. It is anticipated this effort will run several years with hardware programs evolving from the first year's effort.

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(H) Recommendation Report

The preparation of an initial recommendation report and briefing. Seven months from the start of the program, [REDACTED] will make specific written recommendations regarding the five-year program. The recommendations for this continuing program will be the consequence of the results of the program up to that point and assumptions of the capabilities of future collection systems. In the recommendations for subsequent work, major milestones, alternatives, descriptions of function and equipment, estimates of cost, and schedules for completion of each exploitation subsystem and/or technique will be included.

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(I) Exploitation System Concepts

The development of unconventional imagery exploitation system concepts. [REDACTED] will define the requirements for the development of new and improved unconventional imagery exploitation equipment. This requirements definition study will include (but is not limited to) the requirements for comparison viewing, superimposition of different types of images, image manipulation and enhancement, and mensuration.

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(J) Exploitation Equipment Preliminary Design

The preparation of new and improved unconventional imagery exploitation equipment block diagrams and preliminary engineering design characteristics. [REDACTED] will make these preliminary designs of the equipment configurations potentially capable of performing enhancement, mensuration, and multi-sensor viewing. Planning schedules and budgetary cost estimates will be included.

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Attachment # 5

INFORMATION HANDLING PROGRAM

The Information Handling Program is currently directed toward the development of an integrated information system within NPIC which will permit greater utilization of Automatic Data Processing equipment in exploiting the current and predicted increases in the volume of photographic imagery.

The total program is divided into the following four major phases which are being placed under contract sequentially. Phase I, Analysis and Projection of System Requirements, has been completed by the [REDACTED]. A proposal for Phase II, System Design, has been submitted by [REDACTED] and is currently under consideration.

PHASE I. Analysis and Projection of System Requirements:

During this phase substantive information handled by NPIC was reviewed, processing methods and file structures were analysed, flow charts and statistical analyses were prepared of current and projected operations, alternative concepts were developed, and a conceptual design and implementation plan was generated.

PHASE II. System Design:

In this phase alternate methods for performing the system functions, based on the conceptual design resulting from Phase I, will be developed and evaluated. The detailed system configuration and overall operation will be established, detailed specifications for system components will be prepared, and a detailed implementation plan is to be devised.

PHASE III. System Engineering Procurement and Programming:

This phase will encompass the acquisition and test of the system components, both hardware and software, necessary to implement the Phase II design.

PHASE IV. System Installation and Test:

In this final portion of the program, system components will be installed, checked out and tested as a system, personnel will be trained, and all final operation, maintenance and computer documentation will be prepared.

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Attachment # 6

IMAGE ANALYSIS PROGRAM

The Image Analysis Program is designed to provide a better understanding of the fundamental problems of image recording and read-out, and to reformulate image theory in terms of the partial coherence of illumination so that a sound basis may be established for the implementation of the next generation of viewing and reproduction equipment. In addition to this preparation for the future, a thorough analysis is to be made of current problems and weaknesses. Modifications, changes, or reassessment of presently-used equipment and techniques will be made accordingly. The research effort will include such considerations as illumination, optical systems, camera systems (by inference), photographic processes and materials, viewing and evaluating, and the objective interfaces of aerial photography with the interpretive process. The program is a long-range effort, nominally planned for approximately five years.

An initial contract has been issued to [REDACTED] for a one year's effort, with subcontractors of [REDACTED]. The first year's program will be directed toward three main areas: (1) definition of NPIC image analysis problems; (2) theoretical studies of optical, photo-processing, and photometric problems; (3) formulation of lines of investigation for the following four years. The program includes the following 11 tasks:

TASK # 1A - Detailed Definition of Jobs to be Done. After the contractor has become thoroughly familiar with NPIC's image analysis requirements, procedures, and problems he must define in detail the specific tasks to be performed during the life of the task order both by [REDACTED] research personnel and by subcontractors. [REDACTED] will provide justifications, work statements, procedures, and a description of the products of each job to be performed, and will submit these to the Government for approval. A contract review will be held at this time, at approximately two months after initiation. After written approval by the Contracting Officer, [REDACTED] will be responsible for the implementation, conduct, and satisfactory completion of these various jobs, including the selection and work of the subcontractors.

TASK # 1B - Program Review. A review in depth and a documentation reciting the contractor's understanding of NPIC's technical and operational image analysis procedures and requirements. Key contractor personnel shall, through the medium of extended briefing sessions at NPIC and through use of results of other studies conducted in NPIC, become intimately familiar with the nature of the imagery currently being supplied to NPIC as well as anticipated future imagery

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from systems now under development. They will be required to become knowledgeable about the Center's current and future exploitation methods, problems, and requirements in the image analysis field. The contractor's technical representatives must also become familiar with the photo reconnaissance imagery currently exploited by NPIC in order that they may gain the background knowledge needed to attack the Center's imagery exploitation problems.

TASK # 2 - Theoretical and experimental studies will be carried out in the areas of optics, photographs, and photometrics. The Program will involve the solution of problems of increasing complexity to provide guidance for a meaningful theoretical and experimental interaction. The approach to the optical studies will be based on the formulation of imagery in the context of partial coherence, and will include quasi-monochromatic problems as well as the extension to polychromatic conditions. Amplitude, phase, and their combination will be treated. The experimental program shall follow the same pattern or sequence as the theoretical program.

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TASK # 3 - [REDACTED] will work on the imaging properties of grainy films. This will be done in conjunction with experimental investigations at [REDACTED]. They will start by using experimental films supplied by [REDACTED]. They will work from here, both theoretically as well as experimentally, towards the case of films with thicker emulsions and more complicated grain size distributions.

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TASK # 4 - [REDACTED] shall investigate the effective exposure concept. They will construct a series of sine-wave targets on a family of commercially available films of interest to NPIC, using the best possible sensitometric control. The targets will be traced by the microdensitometer and by means of existing [REDACTED] computer programs. The traces will be filtered to remove noise, passed through the H and D curve, and Fourier-analyzed to determine the harmonic content remaining after the density is reduced to effective exposure.

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TASK # 5 -

Theory:

1. Study the theory of the characteristic curve as a function of spatial frequency and as a function of photon noise and photon scatter, especially for high spatial-frequency images.
2. Study the theory of developed photographic density with respect to:

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- a. The opacity of developed silver, especially as a function of layer thickness at high frequency.
 - b. Density at low contrast for high-frequency information.
 - c. The Density-log E relationship at high frequency.
3. Make a preliminary investigation of the optics of the silver photographic images when used as an image source for the preparation of duplicate and multiple generation copies.

Experiment:

1. Analyze in detail commercial emulsions that are of immediate interest to NPIC for calibration purposes.
2. Prepare model emulsions in support of the Theory Program.
3. Set up an electron microscope program that will allow the study of developed filamentary silver, of grain size distributions, and of silver halide crystal structure by the transmission microscopy method, or by the replication method if necessary. Supply support data as dictated by the theoretical study.

TASK # 6 -

1. Re-examine the significance of microdensitometric tracing at high line frequency, establishing:
 - a. The coherence of actual scanning beams; determine where phase effects become significant.
 - b. Edge trace procedures (including statistical approaches) and the variation of the output with the aperture of the condenser and objective optics; standardization of optics and the wavelength band of measurement.

TASK # 7 - Under this task order [REDACTED] will supply the necessary personnel, services, and facilities to:

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1. Investigate the parameters involved in the lens design of optics for spatial filtering systems (image manipulation).
2. Perform work on the imaging properties of grainy films. This will be done in conjunction with experimental investigations at [REDACTED]

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3. Investigate the combined optical properties of viewing equipment and the photointerpreter.

4. Compute the "transfer" function of an aberrated lens in conjunction with the coherence of the illumination of the object.

5. Study the effect of temperature changes on the image quality of lenses of various construction.

6. Perform experiments in conjunction with [REDACTED] on the amount of phase change that can be introduced in various glasses by ion migration.

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TASK # 8 - [REDACTED] will participate in both the theoretical and experimental portion of the Image Analysis Program. In particular [REDACTED] will study the following:

1. The effective exposure concept.
2. The variation of photographic image with depth within the emulsion.
3. Image depth.
4. Edge Trace Analysis.
5. Problem-Oriented-Studies.

This phase of the program will be defined after a series of consultations with the staff at NPIC and detailed in the report for Task # 1A.

TASK # 9 - While the Image Analysis Program is envisioned as a continuing, long-term program the contractor shall deliver a semi-annual report to the Government summarizing the findings of this study.

TASK # 10 - The preparation of an initial recommendation report and briefing. Six (6) months from the start of the program, [REDACTED] shall make specific written recommendations regarding the five-year program. In the recommendations for subsequent work; major milestones, descriptions of future investigations, estimates of cost, and schedules for completion of each exploitation technique will be included.

TASK # 11 - At the end of seven (7) months, [REDACTED] will submit a firm proposal and cost estimate for the following year program and an estimated schedule and costs for the remainder of a five-year program. This in no way obligates the Government to contract such a program.

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Attachment # 7

AUTOMATIC TARGET RECOGNITION PROGRAM

The Automatic Target Recognition Program is a major long-range effort to develop automatic and semi-automatic aids that will increase the speed and accuracy of the photointerpreter. The present program is scheduled to run for five years and will be concerned with specific objectives such as:

1. Screening large volumes of imagery to separate "sterile" portions of the film from those containing possible targets of interest to the imagery analysts;
2. Classifying targets into broad categories;
3. Re-scanning large volumes of previous coverage to search for one type of target of known configuration;
4. Detecting changes in multiple coverage of targets;
5. Providing automatic recognition and correlation of map area to image area in scanning operations;
6. Providing automatic inventory of similar objects within an image field.

A contract has been signed with the [REDACTED] for a nine month effort. The initial contract includes the following eight tasks:

TASK # 1 - Detailed Design Definition Phase. The contractor, working closely with the NPIC technical monitor, shall further define and refine the Automatic Target Recognition Program objectives, Tasks 2, 3, 4, and 5 listed below, in order to assure that the resultant Program will best meet NPIC's present and anticipated requirements. This definition phase will result in a document recording mutually agreeable goals and methodologies for the Program.

TASK # 2 - Analytical Evaluation of Available Techniques. This task shall consist of a thorough literature search and consultation with technical personnel of other industrial concerns, research institutes, and universities to provide a data base for the evaluation of existing automatic target recognition techniques.

TASK # 3 - Analytical and Empirical Studies on Optical Filters. This task shall consist of exploration of optical extraction techniques for the automatic target recognition input sub-system.

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TASK # 4 - Selection, Analysis, and Processing of Imagery. This task shall consist of selection, analysis, and processing of representative imagery which will be supplied by [REDACTED] and by suitable government agencies.

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TASK # 5 - Systems Effectiveness and Evaluation Study. This task shall consist of providing objective evaluation of experimental test results and comparison of various sub-systems and techniques.

TASK # 6 - Contractor's Understanding of NPIC Operations. This task shall consist of a review in depth and result in documentation reciting the contractor's understanding of NPIC operations relating to technical and operational imagery exploitation procedures and requirements. A limited number of key contractor personnel assigned to this program shall, through the medium of extended briefing sessions at NPIC and the results of other studies conducted in NPIC, become intimately familiar with the photo interpretation exploitation of all types of imagery currently being used, as well as imagery from systems now under development. They will be required to become knowledgeable about the Center's current and future photo interpretation exploitation methods. The principal contractor will be given all possible aid in familiarizing himself with the Center's requirements, objectives, materials, and methods of operation and with other NPIC sponsored R&D programs which may affect the Automatic Target Recognition Program.

TASK # 7 - Subsystem Design Specification and Feasibility Test. This task shall consist of evaluation of technique feasibility and development of a set of performance requirements to be met by subsystems under test as elements of an ATR system.

TASK # 8 - Initial Recommendation Report and Briefing. Six months from start of contract, [REDACTED] shall make specific written recommendations in draft form and provide oral briefings regarding a five-year program. The recommendations for subsequent work shall include individual project justification, description, schedules, major milestones, expected results, estimated costs, and alternatives. These recommendations in no way obligate the Government to contract for such a program. In addition, six months from start of contract [REDACTED] shall prepare a Definitive Program Recommendation which shall include schedules and cost estimates for a twelve-month follow-on effort. A contract review will be made by the Government upon completion of this task.

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